IN THE CLAIMS

1. A detector for sensing variations in properties of a fluid flowing in a boundary layer adjacent to the detector, the detector comprising an optical waveguide having a core layer covered by a cladding layer defining a planar surface with an optical grating pattern thereon, whereby when a beam of laser light is directed through the detector as an input, variations in an output of the beam of laser light are indicative changes in fluid pressure or density in the boundary layer adjacent to the grating of the optical waveguide.

2. A detector according to claim 1 wherein the optical waveguide is an optical fiber with a D-shaped cross section defining a planar surface and wherein the core is adjacent to the planar surface and the grating is formed in the cladding.

3. A detector according to claim 2 wherein the grating has a first portion and a second portion, the second portion being spaced from the first portion by a selected distance.

4. A detector according to claim 2 wherein the optical grating pattern is slanted at an angle with respect to the planar surface of the fiber.

5. A detector according to claim 4 wherein the angle is 45°.

6. A system for sensing variations in flow field intensity of a fluid flowing in a boundary layer adjacent to a body exposed to the fluid, the system comprising:

an optical fiber in or on the body, the optical fiber having at least an input, face and an output face and a core covered by cladding; the optical fiber having D-shaped cross-section defining a planar surface adjacent to the core, the planar surface having an optical grating thereon;

a tunable laser for producing an initial laser beam;

a beam splitter disposed between the turnable laser and an input end of the optical fiber for providing a probing beam and a reference beam, wherein the probing beam passes through the optical fiber for interaction with the optical grating;

at least a first detector for receiving the reference beam and producing an output indicative of the amplitude of the the reference beam;

a second sensor receiving the probe beam as modulated by variations in flow field intensity for producing a modulated output indicative of the amplitude of the probe beam as modulated by the grating; and

a comparator connected to the first and second sensors for receiving the reference output and the modulated output and for producing a differential signal indicative of flow field intensity in the boundary layer adjacent to the body.

7. The system of claim 6 wherein the tunable laser is a narrow linewidth tunable laser and wherein an optical chopper is disposed between the laser and the beam splitter.

8. The system of claim 6 wherein the first and second sensors are photodiodes.

9. The system of claim 6 wherein the optical grating is in the core of the optical fiber and comprises at least a first portion and second portion.

10. The system of claim 6 wherein the initial laser beam is oriented at an angle with respect to the input end face of the optical fiber and the grating is slanted at an angle with respect to the planar surface of the optical fiber.

11. The system of claim 6 wherein the optical grating has first and second portions with the first portion having a line spacing corresponding to a first Bragg angle for forward coupling the initial laser beam through the cladding and thus into the second portion of the optical grating; the second portion having a line spacing corresponding to a second Bragg angle coupling for reverse coupling of the laser beam as a reverse laser beam back into the cladding adjacent to the boundary layer and back to the first grating, which first grating through reciprocity couples the reverse laser beam back into the core and out of the entrance face of the fiber for signal detection by the first sensor; the line spacing of the second portion also corresponding to the second Bragg angle configured to minimally forward couple the laser beam back to the core for transmission out of the optical fiber as a probing beam sensed by the second sensor.

12. The system of claim 11 wherein the input end face is disposed at an angle with respect to the longitudinal axis of the optical fiber in order to minimize unwanted front end reflections not necessarily associated with modulated signals of interest.

13. A method for sensing variations in properties of a fluid flowing in a boundary layer adjacent to a detector, the method comprising:

directing a beam of laser light through an optical waveguide having a core layer covered by a cladding layer and defining a planar surface with an optical grating pattern thereon, and detecting variations in an output of the beam of laser light indicative changes in fluid pressure or density in the boundary layer adjacent to the grating of the optical waveguide.

14. A method according to claim 13 wherein the optical waveguide is an optical fiber with a D-shaped cross section and wherein the core is adjacent to the planar surface and the grating pattern is formed in the cladding.

15. A method according to claim 14 wherein the grating pattern has a first portion and a second portion, the second portion being spaced from the first portion by a selected distance.

16. A method of using an optical fiber for sensing variations in flow field intensity of a fluid flowing in a boundary layer adjacent to a body exposed to the fluid, the method comprising:

producing an initial laser beam with a tunable laser;

splitting the laser beam with beam splitter disposed between the turnable laser and an input end of an optical fiber for providing a probing beam and a reference beam;

directing the probing beam through an optical fiber in or on the body, the optical fiber having at least an input face, an output face, a core covered by cladding and a D-shaped cross-section defining a planar surface adjacent to the core, the planar surface having an optical grating thereon;

detecting the reference beam and producing a reference output indicative of the amplitude thereof;

detecting the probe beam as modulated by the conditions in the boundary layer for producing a modulated output indicative of the amplitude of the probe beam as modulated by the grating; and

comparing the reference output and the modulated output to produce a differential signal indicative of flow field intensity in the boundary layer adjacent to the body.

17. The method of claim 16 wherein the laser beam is a narrow linewidth beam from a tunable laser and further including chopping the laser beam before splitting the laser beam.

18. The method of claim 16 wherein the sensors are photodiodes.

19. The method of claim 16 wherein the optical grating is in the core of the optical fiber and comprises at least a first portion and a second portion.

20. The method of claim 16 wherein the initial laser beam is oriented at an angle with respect to the input end face of the optical fiber.

21. The method of claim 16 wherein the optical grating has first and second portions with line spacings corresponding to first and second Bragg angles, respectively; the method comprising:

forward coupling the initial laser beam through the first portion of the optical grating into the second portion of the optical grating;

using the second portion of the grating to reverse couple the laser beam into the cladding adjacent to the boundary layer and sending a reverse laser beam back to the first portion of the grating;

through reciprocity, coupling the reverse laser beam back into the core and out of the inlet face to provide the reference beam for signal detection by the first sensor, while minimally forward coupling a forward laser beam back to the core for transmission out of the optical fiber to provide a modulated probe beam for signal detection by the second sensor.

22. The method of claim 21 comprising minimizing unwanted front end reflections not associated with the modulated signals of interest by disposing the input end face of the optical fiber at an angle with respect to the longitudinal axis of the optical fiber.